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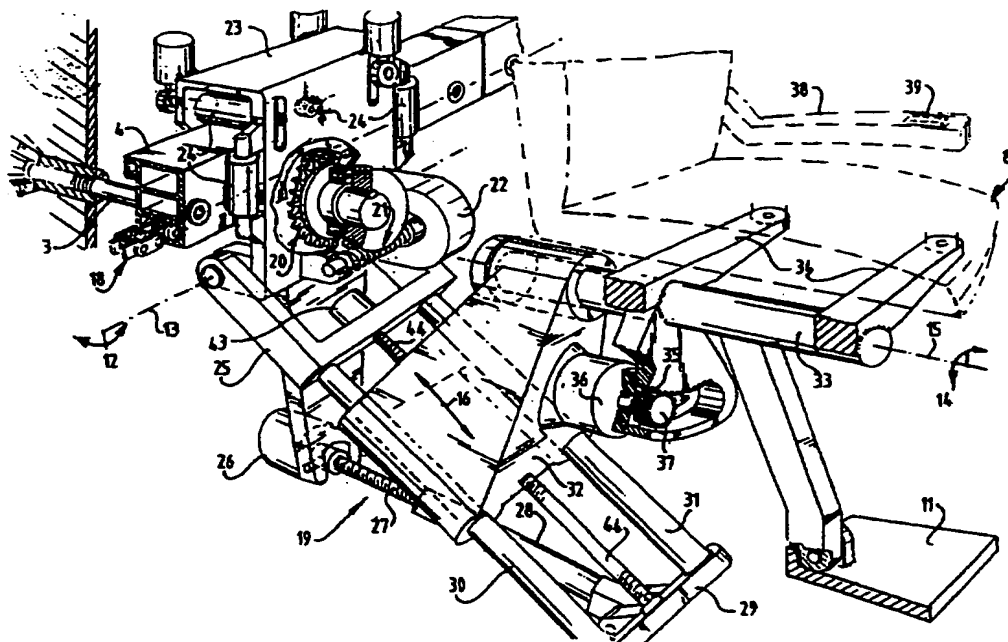
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: **STAIRLIFT**

## (57) Abstract

A stairlift comprises: a main frame (23); support means for supporting this main frame such that it is movable along a support rail (4) which is arranged at some height thereabove along a staircase; a first electric motor (22) for moving the main frame along the support rail; and an auxiliary frame (25) supported by the main frame for carrying a chair, for example a wheelchair, via a support platform such that the auxiliary frame is movable and fixable relative to the main frame by three auxiliary electric motors in two rotation degrees of freedom and one translation degree of freedom.

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**STAIRLIFT**

The invention relates to a stairlift. Such a stairlift is known. A known stairlift has the drawback that the support rail must be placed with great precision and care while avoiding inaccuracies in the angle of inclination, since otherwise the accuracy of the position of the stairlift can depend on its location along the path.

It is an object of the invention to embody a stairlift such that it can function with excellent positional accuracy, even in cases where the support rail has been arranged with relatively little accuracy of positioning.

According to the invention this object is achieved with a stairlift comprising:

15 a main frame;

support means for supporting this main frame such that it is movable along a support rail, which is arranged at some height thereabove along a staircase;

20 a first electric motor for moving the main frame along the support rail; and

an auxiliary frame supported by the main frame for carrying a chair, for example a wheelchair, via a support platform, such that the auxiliary frame is movable and fixable relative to the main frame by three auxiliary electric motors in two rotation degrees of freedom and one translation degree of freedom.

Such a stairlift can have the special feature that the first rotation degree of freedom is intended for up and downward pivoting of the auxiliary frame on a first, at least more or less horizontally extending axis. This first axis can advantageously extend in a plane which coincides with, or is located a short distance from, the main plane of the seat of a chair or wheelchair.

Another special feature of the stairlift can lie in the fact that the second rotation degree of freedom is intended for pivoting the auxiliary frame round a second axis extending substantially transversely of the rail and at least more or less in horizontal direction. This second axis will preferably extend in the median plane of a chair or wheelchair and extend in the main plane of the seat or at a distance thereunder.

Said last two special features can be combined in a variant wherein the first and the second axis are at least more or less intersecting. In this embodiment the two rotation degrees of freedom extend substantially in one plane. The cardan mobility of the auxiliary frame determined by these degrees of freedom ensures a complete adaptability to any angle of inclination defined by the support rail.

The stairlift is further embodied such that it is able to displace in the translation degree of freedom such that a user effectively avoids contact with obstacles. In particular such an embodiment can display the feature that the translation degree of freedom is intended for moving the chair up and downward.

The simplest possible control is ensured with an embodiment in which the three said degrees of freedom are mutually independent.

The stairlift is preferably provided with a battery. This battery is arranged for example on the main frame or the chair, in any case is movable together with the stairlift. The use of cables or drag connections is hereby avoided.

In order to always keep the battery in optimum charged state or to restore the charged state as required, the embodiment is recommended in which on at least one end of the support rail is placed a terminal of a charging device which can co-act with a complementary terminal which is present on the stairlift and which is connected to the battery for charging the battery in the coupled state of said terminals.

A practical embodiment displays the special feature that the first electric motor drives a toothed wheel which can co-act with a toothing arranged on the support rail, for instance a cardan fixed chain supported thereby. The use of a cardan fixed chain offers the option of following not only variations of angle in a vertical plane but also variations of angle in a horizontal plane.

The stairlift is preferably provided with a central control unit for operating by a user. For this purpose use can be made for example of a control unit bearing a plurality of control buttons which is arranged in an arm of the chair.

The stairlift preferably has the special feature that the central control unit is of the self-learning type. This latter embodiment has the advantage that the position adjustment in each of the three degrees of freedom does not have to be programmed in advance depending on the current position of the stairlift, but that through a learning process these positions for a given path of the support rail are automatically followed by the system. In the learning phase it can for example be ensured by external means that during use the chair is situated in each position along the path such that the seat is for instance situated in a substantially horizontal position or displays a selected variation therefrom. A suitable position can be programmed for stepping in and out at both end locations.

The invention will now be elucidated with reference to the annexed drawings, in which:

figure 1 shows a schematic perspective view of a stairlift according to the invention; and

figure 2 shows a partly broken away perspective view on enlarged scale of that part of the stairlift into which the invention is incorporated.

Figure 1 shows a staircase 1 consisting of a plurality of parts, which is bounded on one side by walls 2. A support rail 4 consisting of segments is fixed to

these walls by means of support bolts 3. For the sake of an optimal mechanical strength and safety this support rail 4 is further supported by supports 5 which rest with joint foot plates 6 on the treads 7 of the staircase.

5           As figure 1 shows, the stairlift carries a chair 8 with a seat 9 and a back 10, and a footrest 11 supported by the seat. As will be elucidated below with reference to figure 2, the chair is supported such that it is movable in three degrees of freedom.

10           The first degree of freedom is a rotation degree of freedom, which is indicated with reference numeral 12. In this rotation degree of freedom the chair 8 is pivotable up and downward round an axis 13.

15           In a second rotation degree of freedom 14 the chair 8 is pivotable round an axis 15.

20           In a third degree of freedom, a translation, the chair 8 is movable up and downward. This movement is not strictly vertical but has a vertical component. This degree of freedom is designated in the drawing with the reference numeral 16.

25           As is shown clearly in figure 1, the position of the support rail 4 is greatly variable along its length. The three degrees of freedom of the stairlift according to the invention enable full adaptation thereof. The position variations of the chair 9 are compensated by the rotation degrees of freedom 12 and 14, while the height adjustment is provided by the third degree of freedom 16. This may for instance be necessary to avoid contact between the head of a user and a relatively low ceiling edge 17. Use is made for this purpose of a motor 43 with output spindle shaft 44 which co-acts with a wire (not drawn) present in the block 32.

30           Figure 2 shows that the support rail 4 is open on the underside and supports a cardan linked chain 18. 35           Through driving of the stairlift 19 this chain can co-act with a toothed wheel 20 which is driven by an electric motor 22 via a worm transmission 21. This electric motor 22 is of a relatively heavy type, since it must be

capable of carrying the entire weight of a user and the stairlift 19 upward along the support rail 4. The motor 22 is supported by a main frame 23 which is rollable along support rail 4 by means of rollers generally designated 24.

The main frame 23 supports via an axis 13 an auxiliary frame 25 by means of an electric motor 26 which can drive a threaded spindle 27 and the position of auxiliary frame 25 is adjustable relative to the main frame 23. For this purpose the spindle 27 co-acts with a tube 28 provided with internal thread which co-acts pivotally with a bracket 29 which is connected to an auxiliary frame 25 via sliding rods 30,31. The sliding rods 30,31 serve for slidable guiding of a support block 32 which bears a support shaft 33 rotatably round an axis 15. Supports 34 for the chair 8 are connected to support shaft 33. To the support shaft 33 is connected a toothed bracket 35 which co-acts with a toothed wheel driven by an electric motor 36. By driving the motor 36 the chair 8 can be pivoted round the axis 15. The folding arm-rest 38 carries a control panel 39.

It has not been shown that the stairlift 19 carries rechargeable batteries. Figure 1 shows that a terminal 40 is fixed to the seat of the chair which can co-act with terminals 41,42 of a charging device arranged at the ends of the support rail. The batteries can hereby be recharged in the end positions of the stairlift.

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**CLAIMS**

1. Stairlift, comprising:  
a main frame;  
support means for supporting this main frame  
such that it is movable along a support rail which is  
5 arranged at some height thereabove along a staircase;  
a first electric motor for moving the main  
frame along the support rail; and  
an auxiliary frame supported by the main frame  
for carrying a chair, for example a wheelchair, via a  
10 support platform such that the auxiliary frame is movable  
and fixable relative to the main frame by three auxiliary  
electric motors in two rotation degrees of freedom and  
one translation degree of freedom.
2. Stairlift as claimed in claim 1, wherein the  
15 first rotation degree of freedom is intended for up and  
downward pivoting of the auxiliary frame on a first, at  
least more or less horizontally extending axis.
3. Stairlift as claimed in claim 1, wherein the  
20 second rotation degree of freedom is intended for  
pivoting the auxiliary frame round a second axis  
extending substantially transversely of the rail and at  
least more or less in horizontal direction.
4. Stairlift as claimed in claims 2 and 3,  
25 wherein the first and the second axis are at least more  
or less intersecting.
5. Stairlift as claimed in claim 1, wherein the  
translation degree of freedom is intended for moving the  
auxiliary frame up and downward.
6. Stairlift as claimed in claim 1, wherein the  
30 three said degrees of freedom are mutually independent.
7. Stairlift as claimed in claim 1, comprising  
a battery.
8. Stairlift as claimed in claim 1, wherein on  
at least one end of the support rail is placed a terminal

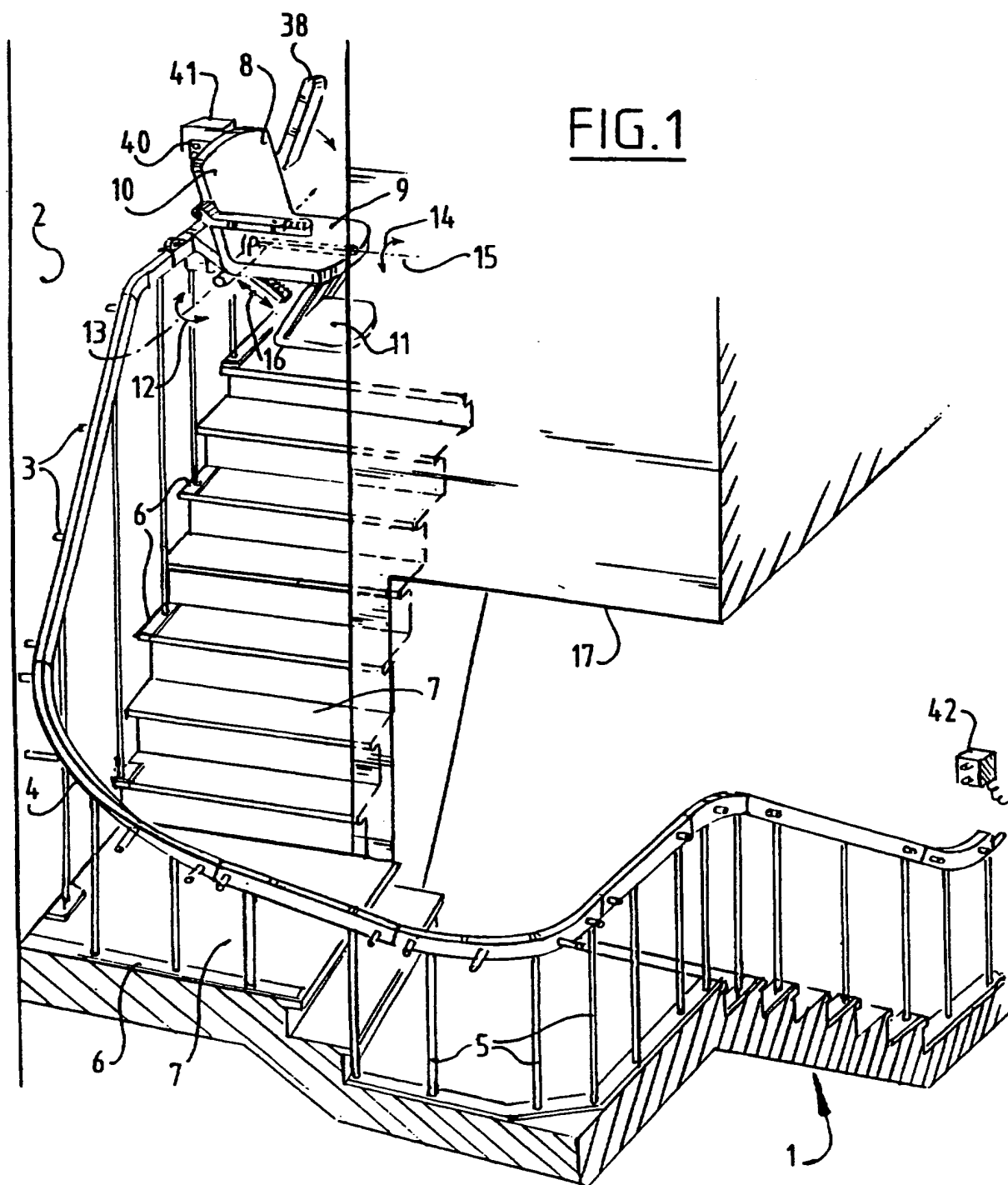
for a charging device which can co-act with a complementary terminal which is present on the stairlift and which is connected to the battery for charging the battery in the coupled state of said terminals.

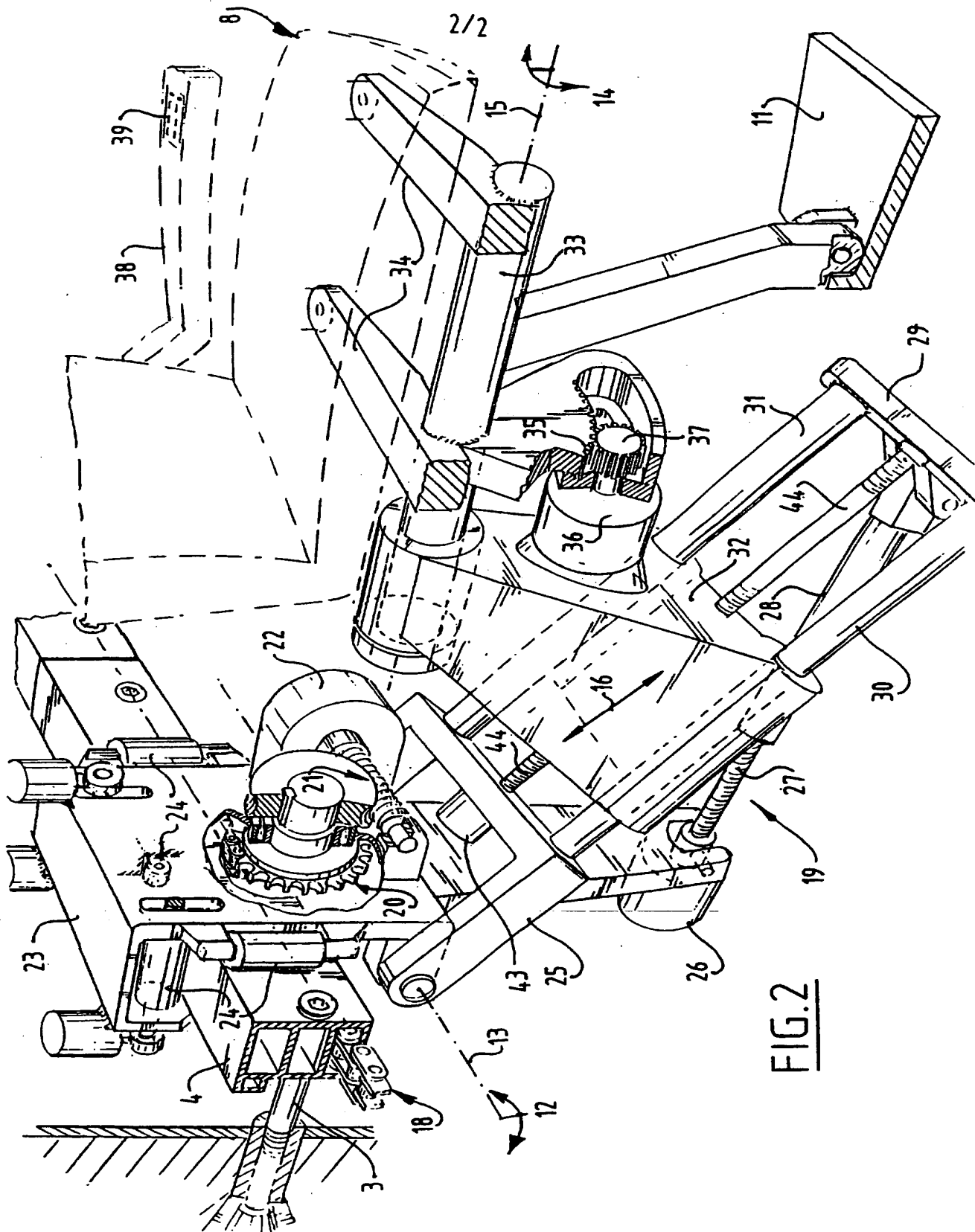
5           9. Stairlift as claimed in claim 1, wherein the first electric motor drives a toothed wheel which can co-act with a toothing arranged on the support rail, for example a cardan fixed chain supported thereby.

10          10. Stairlift as claimed in claim 1, comprising a central control unit for operating by a user.

11. Stairlift as claimed in claim 10, wherein the central control unit is of the self-learning type.

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## INTERNATIONAL SEARCH REPORT

 Int'l Application No  
 PCT/NL 95/00401

 A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 6 B66B9/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

 Minimum documentation searched (classification system followed by classification symbols)  
 IPC 6 B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 560 433 (LIFTENFABRIEK BRINKMAN JAN HAMER B.V.) 15 September 1993 see column 3, line 1 - line 44 ---	1
A	US,A,5 165 753 (HENDERSON ELDRED D) 24 November 1992 see abstract ---	2
A	US,A,5 230 405 (BARTELT ROBERT D) 27 July 1993 see abstract ---	7,8
A	US,A,4 904 916 (GISSKE EDWARD T ET AL) 27 February 1990 see abstract -----	10,11

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☒ Patent family members are listed in annex.

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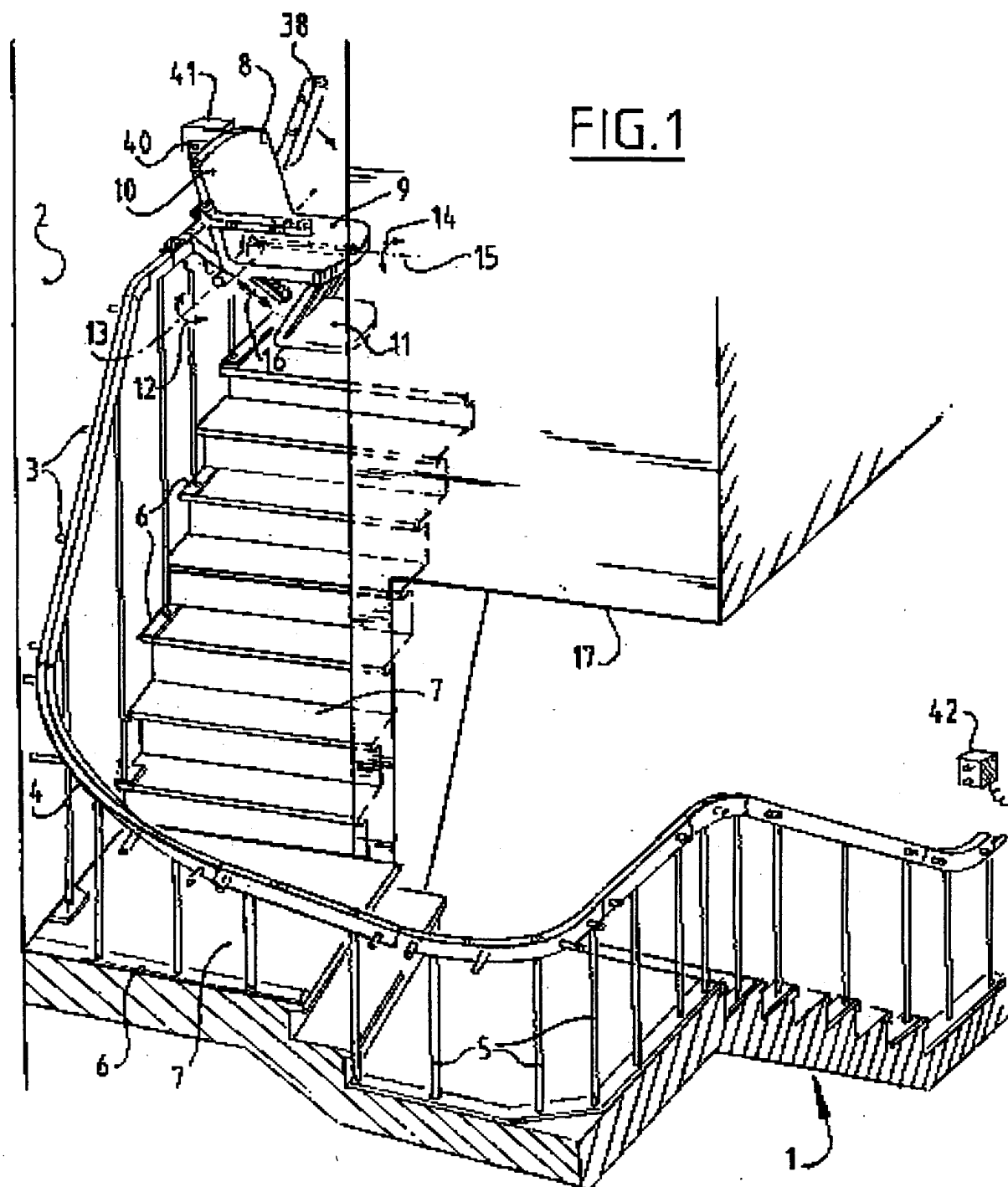
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-560433	15-09-93	NL-A- 9200437	01-10-93
US-A-5165753	24-11-92	NONE	
US-A-5230405	27-07-93	NONE	
US-A-4904916	27-02-90	NONE	

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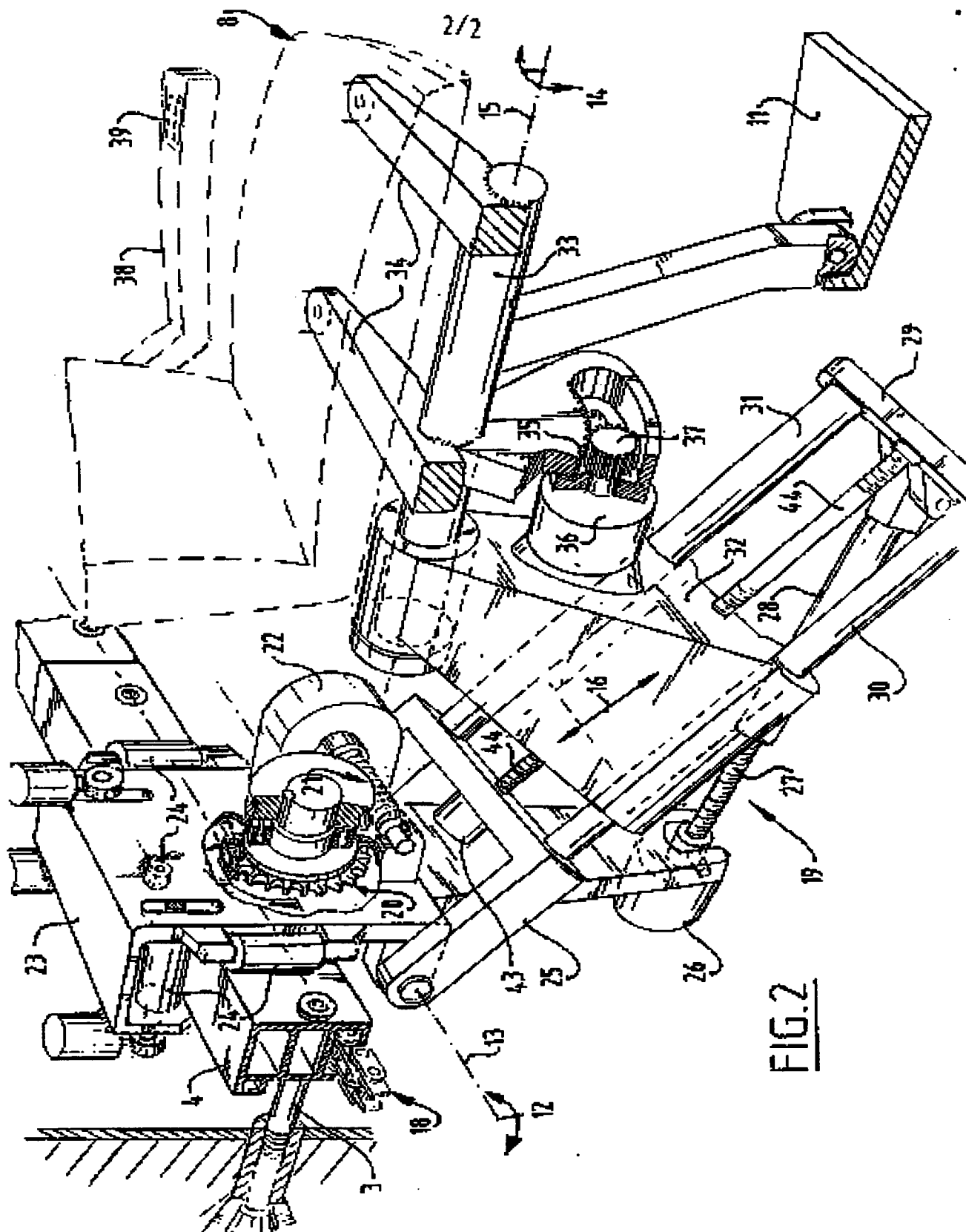


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